EVALUATION OF n + 2H CROSS SECTIONS FOR THE ENERGY RANGE 1.0E-11 to 150 MeV

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1. SUMMARY

This evaluation provides a complete representation of the nuclear data needed for transport, damage, heating, radioactivity, and shielding applications over the incident neutron energy range from 1.0E-11 to 150 MeV. Below 50 MeV the evaluation is based mainly on the ENDF/B-VI.3 (Release 3) evaluation by Young (Yo94).

To summarize, the following ENDF sections are utilized at all energies:

MF=3	MT= 1	Total Cross Section
	MT= 2	Elastic Scattering Cross Section
	MT= 3	Nonelastic Cross Section
	MT= 16	2H(n,2n)1H Cross Section
	MT=102	Radiative Capture Cross Section (Estimate Only at higher energies)
MF=4	MT= 2	Elastic Angular Distributions
MF=6	MT= 16	Production Cross Sections and Energy-Angle Distributions for Emission Neutrons, Protons, Deuterons, and Alphas; and Angle-Integrated Spectra for Gamma Rays and Residual Nuclei That Are Stable Against Particle Emission

The following modifications were made to the ENDF/B-VI.3 evaluation:

1. The (n,2n), elastic, and nonelastic cross sections were revised slightly above 10 MeV to better reflect experimental data;

2. The tabulated elastic scattering angular distributions (MF=4, MT=2) below 3.2 MeV and above 20 MeV were revised slightly to better reflect measurements. The results below 3.2 MeV are based on a couple-channels R-matrix analysis.

2. METHODOLOGY USED IN NEW EVALUATION

The neutron total cross section is based on ENDF/B-VI below 100 MeV and on experimental data between 100 and 200 MeV. The elastic scattering, nonelastic, and 2H(n,2n)1H cross sections were determined above 10 MeV in concert, using the fact that the nonelastic cross section essentially equals the (n,2n) cross section above En ~ 1 keV, and the elastic and nonelastic cross sections must sum to the total cross section. Note that we revised the existing ENDF/B-VI (n,2n) cross section at most energies between 10 and 100 MeV to improve the agreement with experimental data. We also included experimental data for the proton reaction cross section of 2H in our analysis, as we determined empirically that it is entirely consistent with the neutron nonelastic (or reaction) cross section above an incident nucleon energy of about 20 MeV.

The elastic cross section and angular distributions below an incident energy of 4 MeV were validated by comparing to results of a coupled-channels R-matrix analysis. No changes were made to the existing ENDF/B-VI.2 cross section evaluation because the results were consistent with data and the R-matrix analysis; the elastic angular distributions below 3.2 MeV were replaced with tabulated distributions from the R-matrix analysis.

Several elastic scattering angular distribution measurements exist above 20 MeV which we fit with Legendre expansions to get integrated cross sections and to establish the evaluated angular distributions. Especially important are the measurements of Romero, Wang, and Howard, as well as the partial distributions of Yountz and Palmieri. We inferred nonelastic cross sections from the elastic scattering angular distribution measurements above 20 MeV, combined with our evaluated total cross section from experimental data.

We assume that the energy distributions of neutrons from 2H(n,2n)1H follow a pure three-body phase space distribution at all incident neutron energies and utilize LAW=6 in MF=6 to represent these energy distributions.

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REFERENCES

[Ch97]. M.B. Chadwick, P G. Young, and G. M. Hale, "Evaluation of n + 2H Cross Sections," Group T-2 Progress Report for the Accelerator Production of Tritium Program, 1 January - 1 February 1997.

[Yo94]. P. G. Young, "n + D Evaluation to 100 MeV," Release 3, ENDF/B-VI evaluation, distributed April, 1995.